



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4**

**Science and Ecosystem Support Division
Field Services Branch
980 College Station Road
Athens, Georgia 30605-2720**

November 28, 2017

4SESD-FSB

MEMORANDUM

SUBJECT: 2017 Cape Fear River Sediment Oxygen Demand and Nutrient Exchange Study
Project Number 17-0212: Final Report

FROM: Greg White, Physical Scientist *GW*
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THRU: Stacey Box, Chief *[Signature]*
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TO: Jason Green
North Carolina Department of Environmental Quality

Attached is the final report for the Cape Fear River Sediment Oxygen Demand and Nutrient Exchange Study conducted by SESD in June of 2017. An electronic report copy and digital appendix will also be provided. Field and instrument calibration logbooks, chain of custodies, calculation spreadsheets, raw data files, Analytical Support Branch data reports and project correspondence are located in the official project file at SESD and are available upon request. If you have any questions or comments, please feel free to call me at (706) 355-8705.

Attachment

CC: Stacey Box

Project ID: 17-0212

Cape Fear River Sediment Oxygen Demand and Nutrient Exchange Study Final Report

Cape Fear River, NC

Project Date: June 2017



Project Leader: Greg White

Ecology Section

Field Services Branch

Science & Ecosystem Support Division

USEPA – Region 4

980 College Station Road

Athens, Georgia 30605-2720

The activities depicted in this report are accredited under the US EPA Region 4 Science and Ecosystem Support Division ISO/IEC 17025 accreditation issued by the ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation AT-1644.

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1.0 Introduction

The North Carolina Department of Environmental Quality (NCDEQ) requested the assistance of Region 4 Science and Ecosystem Support Division (SESD) Field Services Branch (FSB) in conducting a Sediment Oxygen Demand (SOD) and Nutrient Exchange (NUTX) analysis near four dams along the Cape Fear River. Data collection by SESD included:

- Sediment Oxygen Demand measurements
- Sediment Nutrient Exchange rates.

The Cape Fear River has been experiencing algal blooms, including blue-green algae blooms that have produced the toxin microcystin during recent summers. The results of this study support development of a model used to evaluate the impacts of nutrients along the Cape Fear River. This modeling will help the State understand what conditions and sources are causing these blooms. Data collected by SESD supplements NCDEQ's data in North Carolina's Nutrient Criteria Development Plan, one of the State's pilot projects. The study was conducted according to a Quality Assurance Project Plan (SESDQAPP-170212, 2017), detailing the study area and sampling plan for the project. The QAPP for this study specifies all Standard Operating Procedures for the measurement and sample collection methods used during this study.

2.0 Study Area and Sampling Plan

SESD collected data along the Cape Fear River during the week of June 5, 2017. The study area consisted of 4 stations within the Central portion of the Cape Fear basin and covered approximately 127 river miles. SOD and NUTX measurements were collected at all 4 sites. Sites were located near Lock and Dam 1, Lock and Dam 2, Lock and Dam 3, and Buckhorn Dam along the Cape Fear River. Site locations were determined by NCDEQ based on modeling needs and accessibility. An overview of all sampling locations is shown in Figure 1. Figures 2 through Figures 5 display satellite imagery of all sample locations and corresponding boat ramps. Site names, locations, and descriptions are listed in Table 1.

Table 1: Sampling Locations and Descriptions

Station ID	Latitude	Longitude	Site Description
LD1	34.40875°	-78.29768°	Lock & Dam 1 SOD/NUTX Site
LD1 Ramp	34.40324°	-78.29325°	Lock & Dam 1 Boat Ramp
LD2	34.65297°	-78.64113°	Lock & Dam 2 SOD/NUTX Site
LD2 Ramp	34.63245°	-78.60385°	Lock & Dam 2 Boat Ramp
LD3	35.10202°	-78.85783°	Lock & Dam 3 SOD/NUTX Site
LD3 Ramp	35.04654°	-78.85747°	Lock & Dam 3 Boat Ramp
BD	35.54255°	-79.00192°	Buckhorn Dam SOD/NUTX Site
BD Ramp	35.55071°	-79.02507°	Buckhorn Dam Boat Ramp

3.0 Field Methods

Methodology for the SOD and NUTX measurements completed by SESD are summarized in the following sections. The measurement uncertainties associated with the field methods used can be found in Table 2. Station locations were recorded in field logbooks according to SESD Operating Procedure for Global Positioning Systems (SESDPROC-110-R4, 2015). The field

logbooks were used and maintained after the project by the project leader with the project file according to SESD Operating Procedures for Control of Records (SESDPROC-002-R6, 2014) and Logbooks (SESDPROC-010-R5, 2013). This report will be distributed and stored per SESD Report Preparation and Distribution Operating Procedures (SESDPROC-003-R5, 2014) after final approvals.

Table 2: Measurement Uncertainties

In Situ and Field Parameters	Units	Measurement Technology	Sensitivity of Primary Equipment
Dissolved Oxygen	mg/l	Luminescent DO Probe	± 0.1 mg/l $\pm 1\%$ Reading
Temperature	°C	LDO Thermistor	± 0.3 °C
Latitude/Longitude	decimal degrees	DGPS/GPS based on NAD83	± 10 m (w/ selective availability disabled)

3.1 Sediment Oxygen Demand

To evaluate sediment oxygen demand, SESD personnel followed procedures per SESD Operating Procedure for Sediment Oxygen Demand (SESDPROC-507-R4, 2015). SOD measurements were conducted at stations LD1, LD2, LD3, and BD. At each sampling location, two or more replicate contact chambers of known volume and surface area were deployed over the bottom sediment. Multi-parameter sondes were used to monitor DO and temperature within each SOD chamber in accordance with SESD Operating Procedure for In Situ Water Quality Monitoring (SESDPROC-111-R3, 2013).

The decline in dissolved oxygen concentration was measured within the multiple contact chambers over a sufficient period (generally up to 1.5 hours) to provide adequate data for linear regression analyses with the DO decline expressed in mg/L/min. The DO decline was then multiplied by a factor of 1.44 to express the DO decline in grams O₂/L/day, then further multiplied by the chambers surface area to volume ratio of 240 yielding a SOD rate expressed in grams O₂/m²/day. Simultaneously, at least 1 blank chamber (i.e. filled with bottom water but no contact with sediment) was deployed in a similar fashion in order to determine water column DO respiration. Blank chamber(s) were allowed to settle for up to 30 minutes prior to commencement of data collection. This allowed for suspended sediment to settle out and sufficient time to displace ambient surface water in the blank chamber with ambient bottom water. DO measurements were recorded at five minute intervals over the longevity of chamber deployment (incubation period).

3.2 Nutrient Exchange

To evaluate sediment nutrient exchange, an initial and final water sample was collected by divers utilizing a pre-cleaned underwater siphon system to siphon the sample from each of the chambers into a 250 mL pre-cleaned glass container, as outlined in the SESD Operating Procedure for Sediment Oxygen Demand (SESDPROC-507-R4, 2015). After the initial sample collection, chambers were allowed to incubate for as long as environmental conditions provided and DO

concentrations were continuously monitored so the chambers would not go anoxic prior to final sample collection.

Nutrient exchange samples were analyzed for Ammonia (NH_3), Total Kjeldahl Nitrogen (TKN), Nitrate + Nitrite ($\text{NO}_2 + \text{NO}_3$), and Total Phosphorous (TP). Nutrient samples were preserved with a 10% solution of sulfuric acid (H_2SO_4). Samples were preserved with sufficient preservative to lower the sample pH to less than 2 and placed on ice. All sediment nutrient exchange samples were collected according to SESD Operating Procedure for Surfacewater Sampling (SESDPROC-201-R4, 2016). Analytical methods, minimum reporting limits, and holdings times are provided in the Analytical Support Branch Laboratory Operations and Quality Assurance Manual (SESD ASB, 2017).

4.0 Field Results and Discussion

Field work along the Cape Fear River occurred from June 5th until June 8th of 2017. Sampling station LD1 was moved slightly upstream to avoid a potential harmful discharge. LD3 was moved mid-day to find deeper, slower moving water as several chambers were unable to maintain proper contact with the sediment due to high water velocities. BD was moved closer to Buckhorn Dam to locate more representative environmental conditions. All station relocations were discussed and approved by the project requester.

4.1 Sediment Oxygen Demand

SOD measurements were conducted at stations LD1, LD2, LD3, and BD. Ambient DO measurements indicated aerobic conditions at all stations where chamber SOD measurements were made. SOD stations were measured moving from downstream to upstream along the Cape Fear River, however no discernable trends were present along the sampling path. Stations LD1, LD2, and LD3 were characterized by similar sandy sediments and faster moving water. The slowest mean SOD rate measured was -0.61 grams $\text{O}_2/\text{m}^2/\text{day}$ at LD1, while the fastest rate was -1.36 grams $\text{O}_2/\text{m}^2/\text{day}$ at BD. Station BD was characterized by organic debris in the sediments and slower moving water. Slow water velocities typically allow for more organic material to be deposited into the sediment and SOD rates generally increase as the concentration of organic matter increases. The SOD rate from chamber 1 at BD was significantly higher than the other chambers due the presence of woody debris in the sediment, however the data was still deemed valid as it represented environmental conditions observed by divers at the station. All logged data is provided in the digital appendix of the report. Mean SOD rates are summarized below in Table 3. More detailed SOD data is presented in Appendix A.

Table 3: Mean SOD Rate Results

Station	Date	Mean Temp (°C)	Unadjusted DO Rate (mg/L/min)	Adjusted* SOD Corrected to 20°C (gr $\text{O}_2/\text{m}^2/\text{day}$)
LD1	6/5/2017	25.65	-0.00286	-0.61
LD2	6/6/2017	25.83	-0.00413	-0.95
LD3	6/7/2017	25.93	-0.00337	-0.74
BD	6/8/2017	24.19	-0.00574	-1.36

*Adjusted for water column respiration

4.2 Nutrient Exchange

Nutrient exchange measurements were collected at stations LD1, LD2, LD3, and BD. The water column during the course of this study was well mixed with aerobic conditions overlying the sediments throughout the incubation period. Nutrient flux rates were minimal or inconclusive with bottom sediments, however, trends observed are discussed below. Ammonia calculations were not included as the overwhelming majority of samples were below the Method Reporting Limit (MRL) of 0.05 mg/L. Complete NUTX data, calculations, and data qualifiers are presented in Appendix B. The full analytical data report is provided in the digital appendix as referenced in the cover memo of this report.

Total Phosphorous (TP) concentrations were the only tested parameter consistent within each chamber. Although TP consistently decreased from initial to final samples, the changes within chambers were small across varied incubation times between stations. It should be noted that TP rates within the blank chambers were similar to the TP rates in the contact chambers. This indicates the water column was the primary factor affecting nutrient exchange rates.

Ammonia, Nitrate/Nitrite, and TKN results were all inconsistent as the nutrient concentrations increased in some chambers and decreased in others at the same site for all sampling stations. These inconsistencies indicate the values likely do not accurately reflect environmental conditions. However, it should be noted initial concentrations of TKN were much higher in each chamber than ammonia concentrations, which indicates the vast majority of nitrogen in the water column is organic in nature.

5.0 Quality Assurance and Quality Control

The only known notable quality assurance and quality control issue associated with this project is the exceedance of holding times for TKN analysis. The various data qualifiers associated with these samples were provided by the laboratory and are shown in Table B5. The nutrient exchange data with data qualifiers was still deemed valid for its intended use.

Quality control procedures were utilized in the field and during preparation of equipment to ensure reliable data was obtained. Per SESD's Field Branches Quality System, the Project Leader and Project Participants assisting with this project were deemed competent by SESD management under ISO 17025 accreditation to conduct the tasks required to fulfill the prescribed goals described. All calibration standards, field equipment, field supplies, and field consumables were maintained in accordance with SESD Operating Procedure's for Equipment Inventory and Management (SESDPROC-108-R5, 2015), Field Temperature Measurement (SESDPROC-102-R4, 2014), and Field DO Measurement (SESDPROC-106-R4, 2017).

All instruments or equipment used by SESD personnel to conduct field sampling and measurement activities were calibrated and end-checked in accordance with SESD Operating Procedures for In Situ Water Quality Monitoring (SESDPROC-111-R3, 2013), SESD Operating Procedure for Surfacewater Sampling (SESDPROC-201-R4, 2016), and the SESD form for acceptance criteria (SESDFORM-060-R0, 2017).

All data derived from SEDS field measurements and sampling was reviewed, verified, validated and deemed usable in accordance with the SEDS Operating Procedure for Report Preparation and Distribution (SESDPROC-003-R5, 2014).

All samples were accompanied by a chain of custody (COC), handled and maintained according to the SEDS Operating Procedures for Sample and Evidence Management (SESDPROC-005-R3, 2016) and Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples (SESDPROC-209-R3, 2015). All critical supplies and consumables for this field investigation were inspected and maintained in accordance with SEDS Operating Procedures for Purchasing of Services and Supplies (SESDPROC-015-R5, 2015) and for Field Sampling Quality Control (SESDPROC-011-R5, 2017).

6.0 References

SESD ASB. (2017). Laboratory Operations and Quality Assurance Manual (ASB LOQAM). Athens, GA: U.S. EPA Region 4.

SESDFORM-060-R0. (2017). SEDS Form for Acceptance Criteria. Athens, GA: U.S. EPA Region 4.

SESDQAPP-170212. (2017). 17-0212 Cape Fear River Sediment Oxygen Demand and Nutrient Exchange Study QAPP. Athens, GA: U.S. EPA Region 4.

SESDPROC-002-R6. (2014). SEDS Operating Procedure for Control of Records. Athens, GA: U.S. EPA Region 4.

SESDPROC-003-R5. (2014). SEDS Operating Procedure for Report Preparation and Distribution. Athens, GA: U.S. EPA Region 4.

SESDPROC-005-R3. (2016). SEDS Operating Procedure for Sample and Evidence Management. Athens, GA: U.S. EPA Region 4.

SESDPROC-010-R5. (2013). SEDS Operating Procedure for Logbooks. Athens, GA: U.S. EPA Region 4.

SESDPROC-011-R5. (2017). SEDS Operating Procedure for Field Sampling Quality Control. Athens, GA: U.S. EPA Region 4.

SESDPROC-015-R5. (2015). SEDS Operating Procedure for Purchasing of Services and Supplies. Athens, GA: U.S. EPA Region 4.

SESDPROC-102-R4. (2014). SEDS Operating Procedure for Field Temperature Measurement. Athens, GA: U.S. EPA Region 4.

SESDPROC-106-R4. (2017). SEDS Operating Procedure for Field DO Measurement. Athens, GA: U.S. EPA Region 4.

SESDPROC-108-R5. (2015). SEDS Operating Procedure for Equipment Inventory and Management. Athens, GA: U.S. EPA Region 4.

SESDPROC-110-R4. (2015). SEDS Operating Procedure for Global Positioning Systems. Athens, GA: U.S. EPA Region 4.

SESDPROC-111-R3. (2013). SEDS Operating Procedure for In Situ Water Quality Monitoring. Athens, GA: U.S. EPA Region 4.

SESDPROC-201-R4. (2016). SEDS Operating Procedure for Surfacewater Sampling. Athens, GA: U.S. EPA Region 4.

SESDPROC-209-R3. (2015). SEDS Operating Procedure Packing, Marking, Labeling, and Shipping of Environmental and Waste Samples. Athens, GA: U.S. EPA Region 4.

SESDPROC-507-R4. (2015). SEDS Operating Procedure for Sediment Oxygen Demand. Athens, GA: U.S. EPA Region 4.

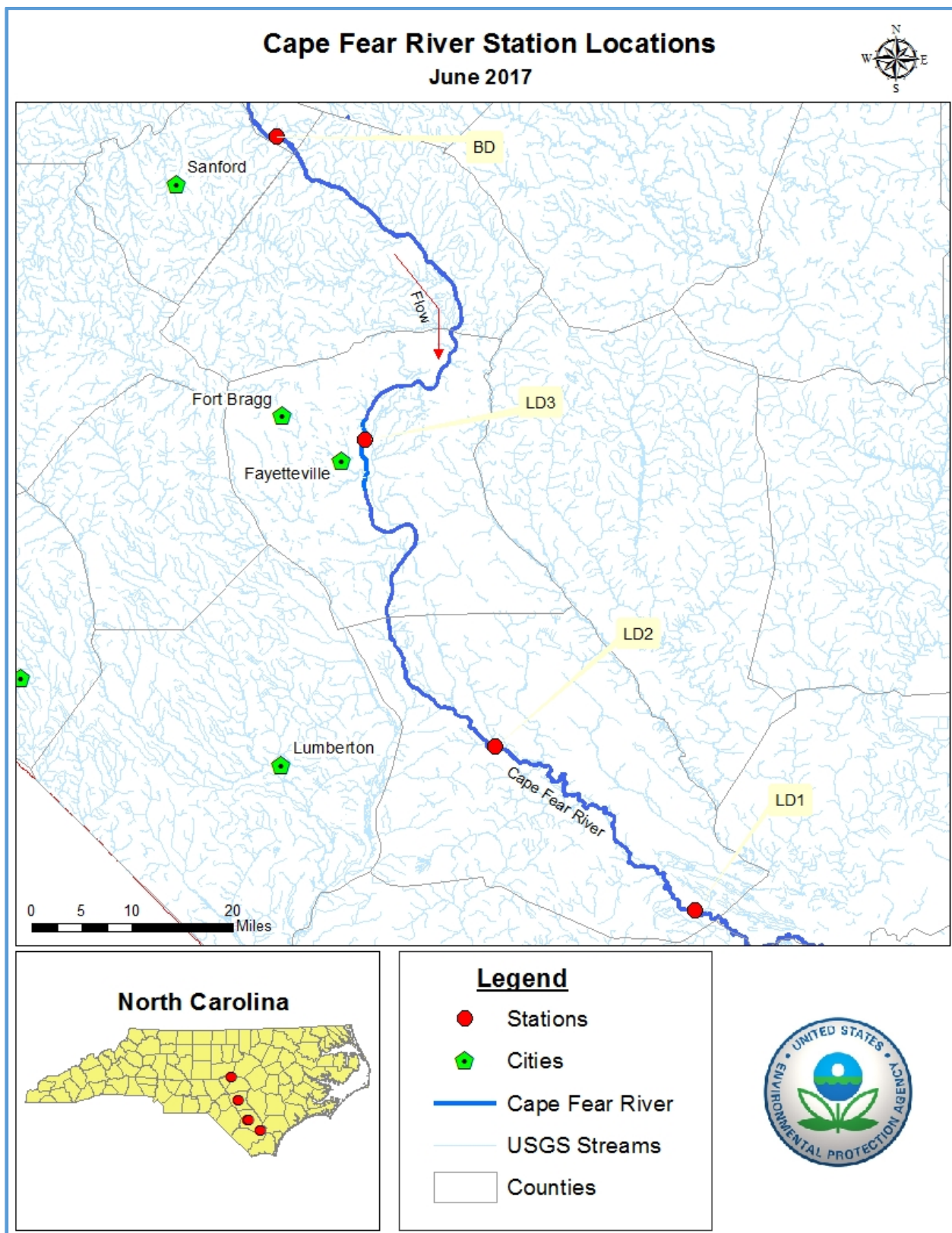


Figure 1: Overview of Sampling Locations

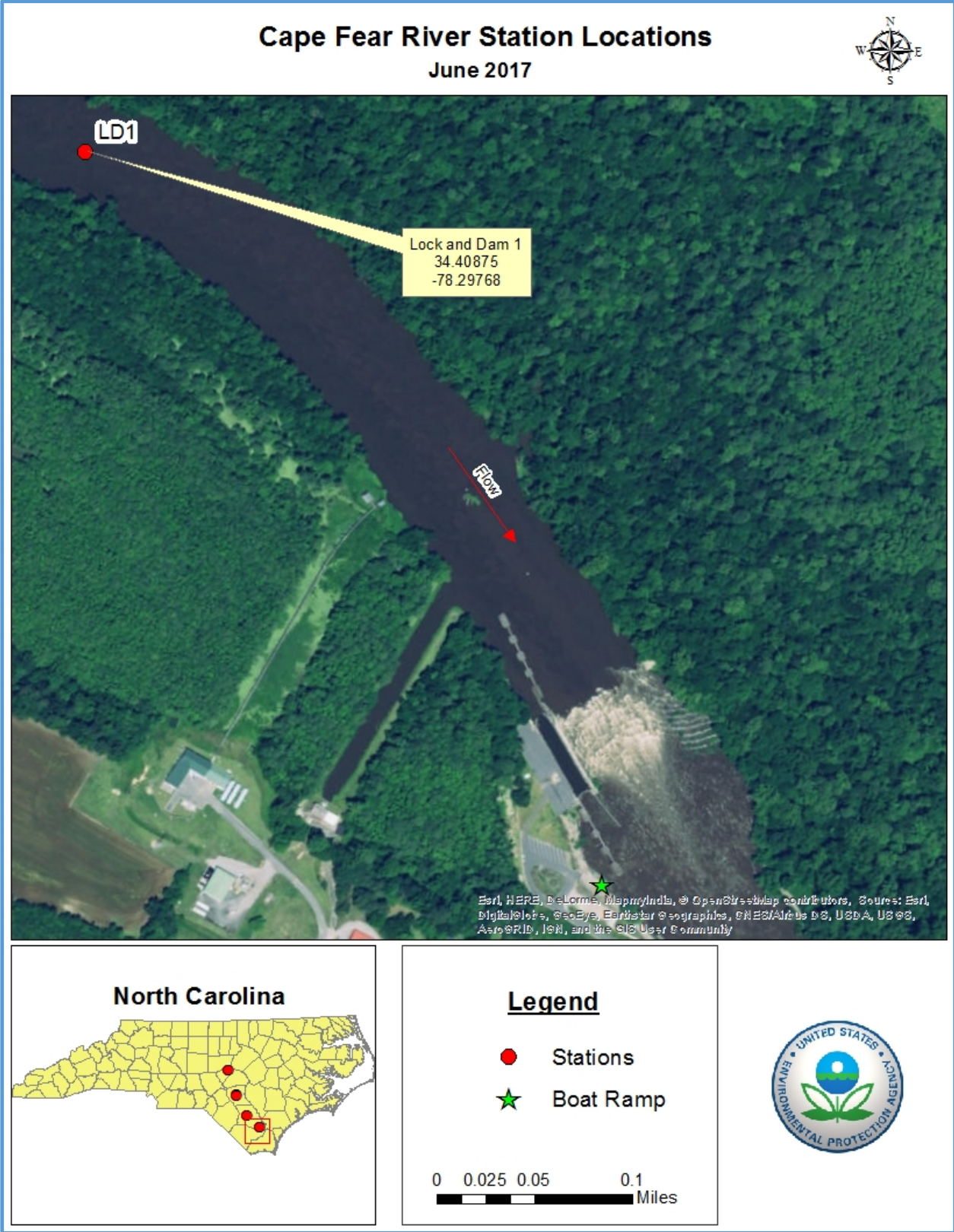
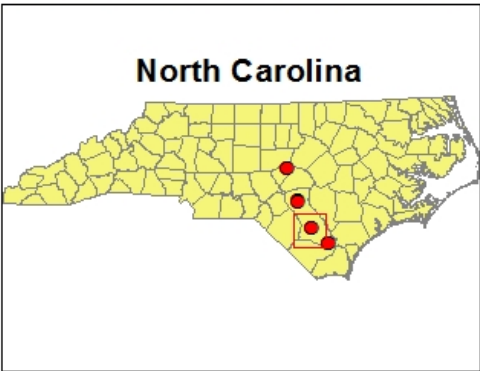


Figure 2: LD1 Station Location

Cape Fear River Station Locations

June 2017



Legend

- Stations
- ★ Boat Ramp

0 0.175 0.35 0.7 Miles



Figure 3: LD2 Station Location

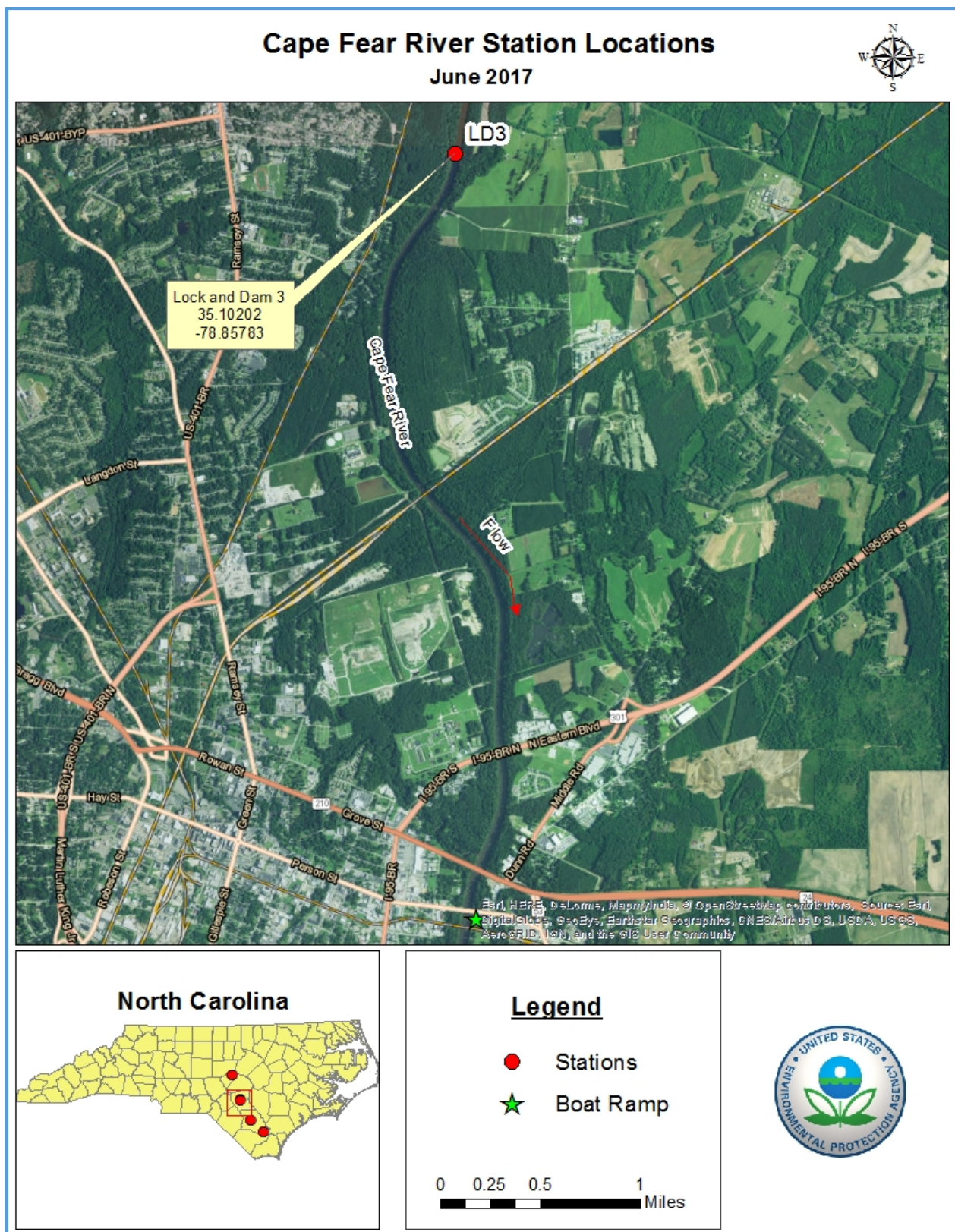


Figure 4: LD3 Station Location

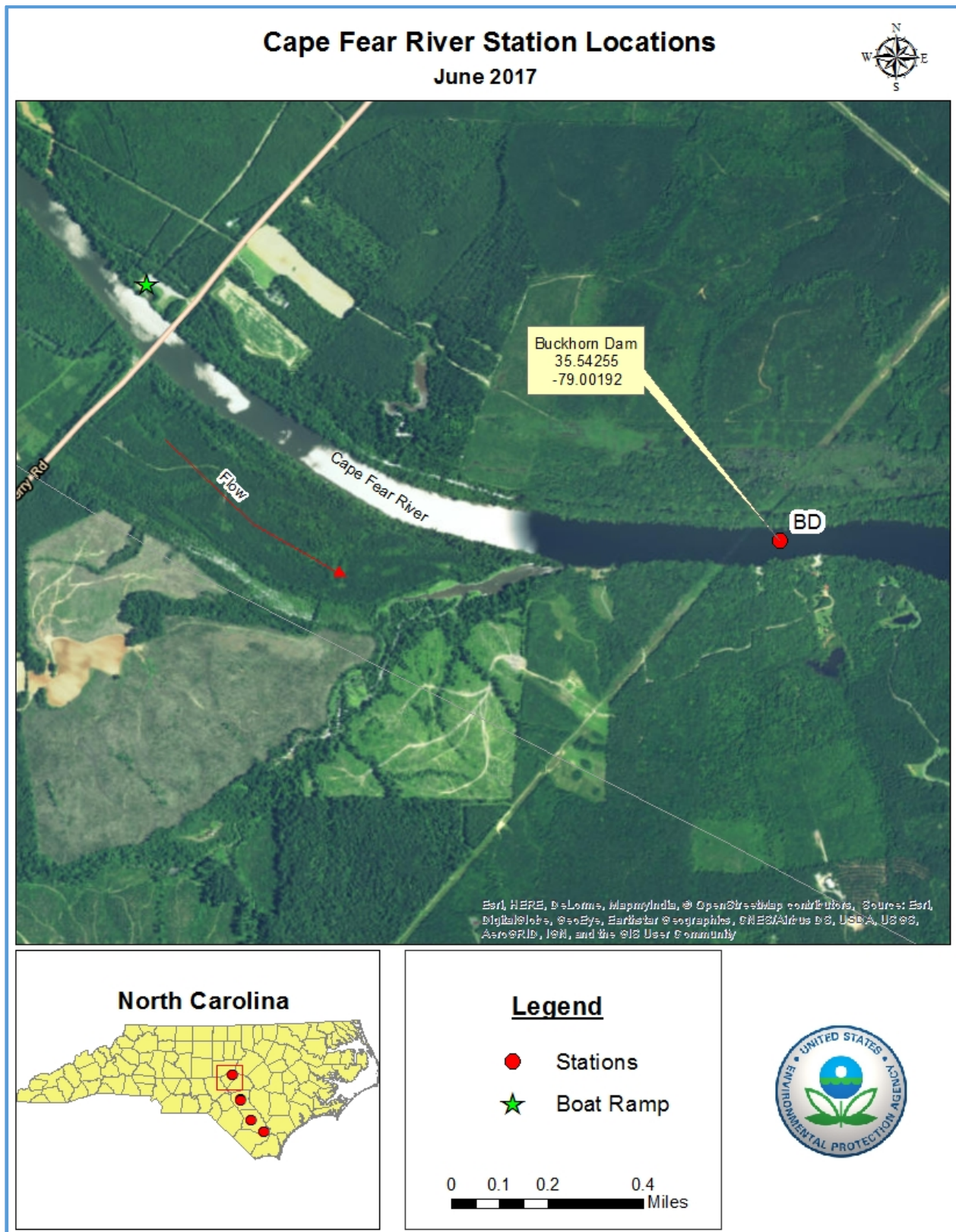


Figure 5: BD Station Location

Appendix A: SOD Data

Table A1: SOD Summary Data

STATION	CHAMBER	MEAN TEMP °C	UNADJUSTED		ADJUSTED*		W. COLUMN RESP.		SOD* (gr O ₂ /m ² /d)	SOD* @ 20°C (gr O ₂ /m ² /d)	STND. DEV. (gr O ₂ /m ² /d)
			RATE (mg/l/min)	D.O.	RATE (mg/l/min)	D.O.	(mg/l/min)	(gr O ₂ /m ² /d)			
LD1 6/5/2017	1	25.62	-0.00268		-0.00233				-0.81	-0.56	
	2	25.70	-0.00290		-0.00254				-0.88	-0.62	
	3	25.63	-0.00230		-0.00195				-0.67	-0.47	
	4	25.62	-0.00356		-0.00321				-1.11	-0.78	
	0	25.67					-0.00020				
	00	25.63					-0.00050				
Station Mean:			-0.00286		-0.00251		-0.00035		-0.87	-0.61	0.13
LD2 6/6/2017	1	26.06	-0.00484		-0.00467				-1.62	-1.12	
	2	25.78	-0.00448		-0.00432				-1.49	-1.03	
	3	25.79	-0.00254		-0.00237				-0.82	-0.57	
	4	25.80	-0.00464		-0.00447				-1.54	-1.07	
	0	25.84					-0.00011				
	00	25.72					-0.00023				
Station Mean:			-0.00413		-0.00396		-0.00017		-1.37	-0.95	0.26
LD3 6/7/2017	1	25.91	-0.00339		-0.00314				-1.09	-0.75	
	2	25.98	-0.00420		-0.00395				-1.36	-0.94	
	3	25.90	-0.00293		-0.00268				-0.93	-0.64	
	4	25.90	-0.00297		-0.00271				-0.94	-0.65	
	0	25.96					-0.00012				
	00	25.92					-0.00039				
Station Mean:			-0.00337		-0.00312		-0.00025		-1.08	-0.74	0.14
BD 6/8/2017	1	24.17	-0.00934		-0.00874				-3.02	-2.32	
	2	24.23	-0.00442		-0.00382				-1.32	-1.01	
	3	24.17	-0.00431		-0.00371				-1.28	-0.98	
	4	24.17	-0.00488		-0.00427				-1.48	-1.13	
	0	24.23					-0.00059				
	00	24.18					-0.00062				
Station Mean:			-0.00574		-0.00513		-0.00061		-1.77	-1.36	0.64

* ADJUSTED FOR WATER COLUMN RESPIRATION

**Chambers 1 through 4 were in contact with the sediment. Chambers 0 and 00 were 'blanks' and represent water column respiration.

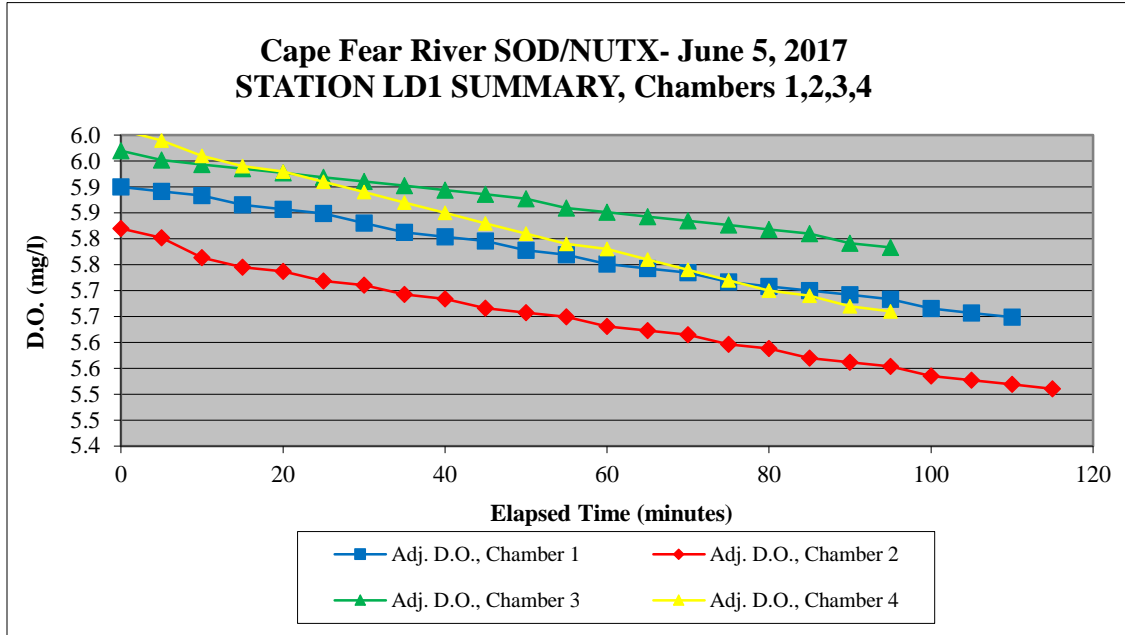


Figure A1: Station LD1 SOD Data

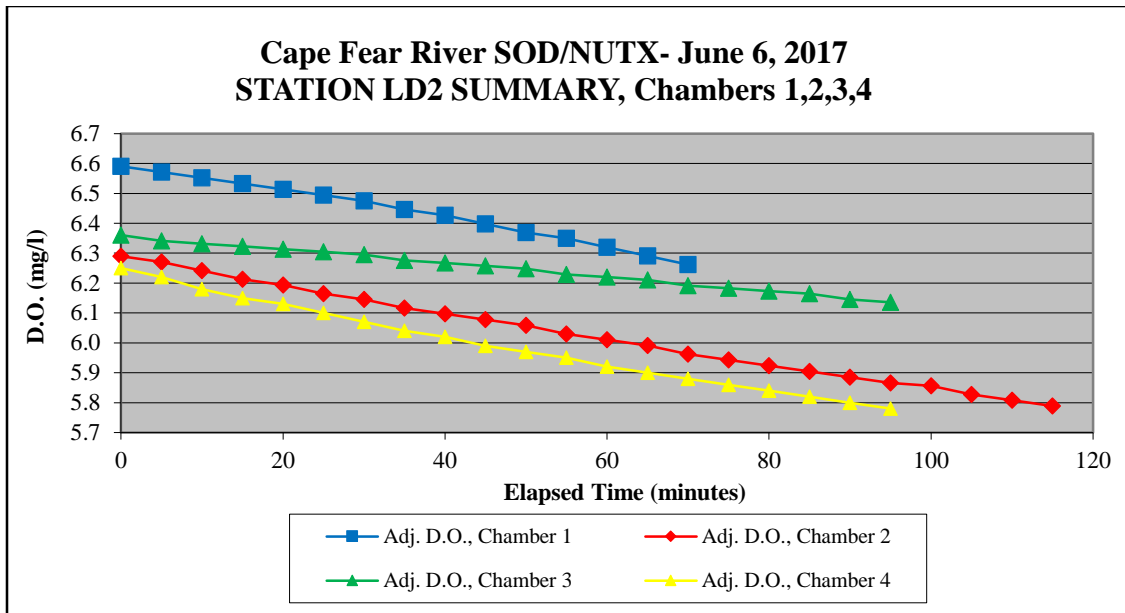


Figure A2: Station LD2 SOD Data

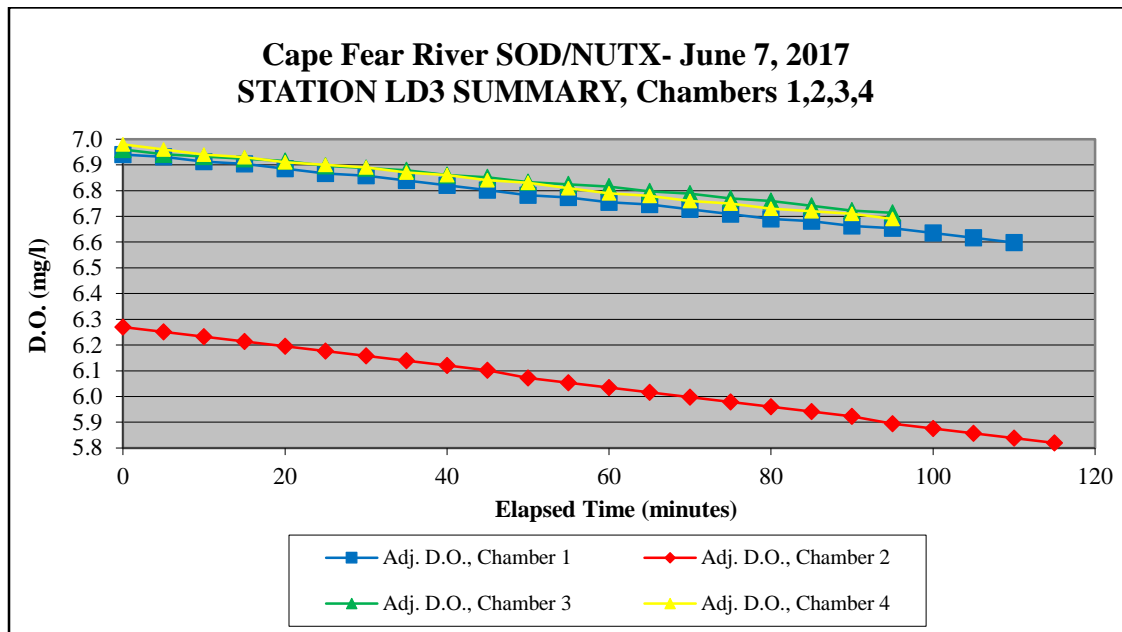


Figure A3: Station LD3 SOD Data

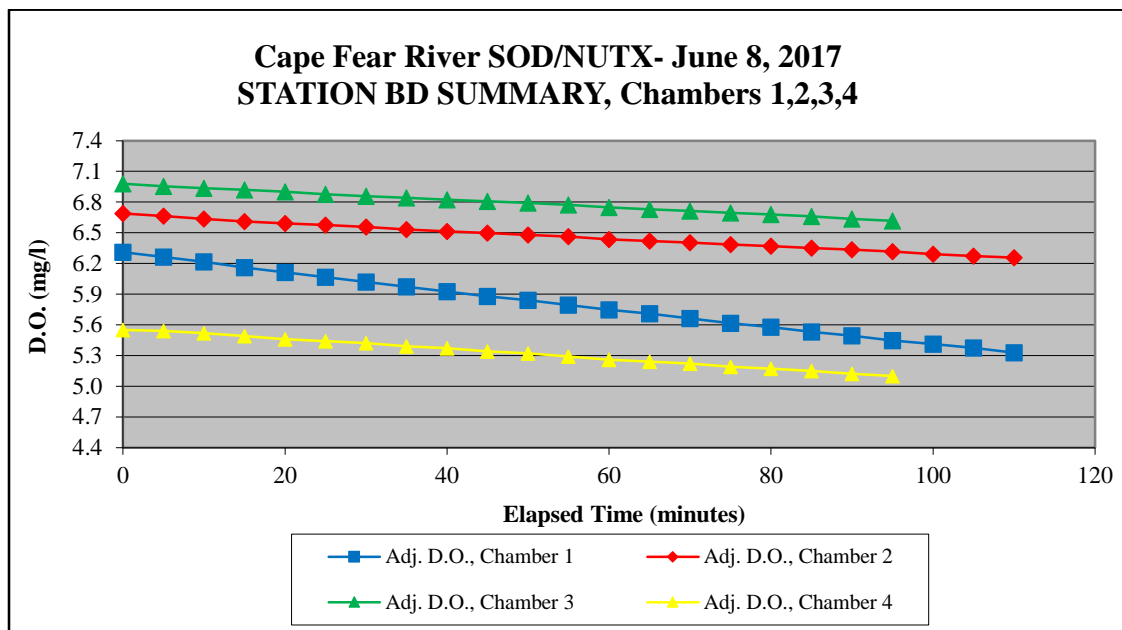


Figure A4: Station BD SOD Data

Appendix B: NUTX Data

Table B1: Station LD1 NUTX Summary - June 5, 2017

Sample	Time	HOURS	MIN.	ET	NO ₃ +NO ₂	gr NO ₃ +NO ₂ /m ² /day	TKN	gr TKN/m ² /day	TP	gr Total P/m ² /day
CFR-LD1-0617-00F	18:20	18	20		0.54		0.58		0.11	
CFR-LD1-0617-00I	13:48	13	48	272	0.53	0.0127	0.54	0.0508	0.12	-0.0127
CFR-LD1-0617-0F	18:21	18	21		0.54		0.48		0.12	
CFR-LD1-0617-0I	13:57	13	57	264	0.53	0.0131	0.55	-0.0916	0.12	0.0000
CFR-LD1-0617-1F	18:12	18	12		0.50		0.53		0.14	
CFR-LD1-0617-1I	14:02	14	2	250	0.52	-0.0276	0.65	-0.1659	0.15	-0.0138
CFR-LD1-0617-2F	18:17	18	17		0.47		0.62		0.12	
CFR-LD1-0617-2I	13:58	13	58	259	0.51	-0.0534	0.64	-0.0267	0.13	-0.0133
CFR-LD1-0617-3F	18:16	18	16		0.54		0.58		0.12	
CFR-LD1-0617-3I	13:54	13	54	262	0.53	0.0132	0.56	0.0264	0.14	-0.0264
CFR-LD1-0617-4F	18:11	18	11		0.54		0.46		0.11	
CFR-LD1-0617-4I	13:51	13	51	260	0.54	0.0000	0.46	0.0000	0.13	-0.0266
STATION MEAN NUTRIENT EXCHANGE RATE (gr/m ² /day):							-0.030	-0.021		-0.014

*See Table B5 for data qualifiers

**Chambers 1 through 4 were in contact with the sediment. Chambers 0 and 00 were 'blanks' and represent water column respiration.

Table B2: Station LD2 NUTX Summary - June 6, 2017

Sample	Time	HOURS	MIN.	ET	NO ₃ +NO ₂	gr NO ₃ +NO ₂ /m ² /day	TKN	gr TKN/m ² /day	TP	gr Total P/m ² /day
CFR-LD2-0617-00F	18:10	18	10		0.60		0.40		0.11	
CFR-LD2-0617-00I	12:15	12	15	355	0.59	0.0097	0.44	-0.0389	0.12	-0.0097
CFR-LD2-0617-0F	18:18	18	18		0.60		0.49		0.11	
CFR-LD2-0617-0I	12:12	12	12	366	0.60	0.0000	0.58	-0.0850	0.12	-0.0094
CFR-LD2-0617-1F	18:22	18	22		0.58		0.53		0.12	
CFR-LD2-0617-1I	12:16	12	16	366	0.60	-0.0189	0.53	0.0000	0.13	-0.0094
CFR-LD2-0617-2F	18:25	18	25		0.52		0.58		0.11	
CFR-LD2-0617-2I	12:20	12	20	365	0.59	-0.0663	0.52	0.0568	0.12	-0.0095
CFR-LD2-0617-3F	18:24	18	24		0.59		0.44		0.12	
CFR-LD2-0617-3I	12:25	12	25	359	0.60	-0.0096	0.47	-0.0289	0.12	0.0000
CFR-LD2-0617-4F	18:21	18	21		0.57		0.45		0.11	
CFR-LD2-0617-4I	12:30	12	30	351	0.59	-0.0197	0.56	-0.1083	0.12	-0.0098
STATION MEAN NUTRIENT EXCHANGE RATE (gr/m ² /day):							-0.033	0.042		0.002

*See Table B5 for data qualifiers

**Chambers 1 through 4 were in contact with the sediment. Chambers 0 and 00 were 'blanks' and represent water column respiration.

Table B3: Station LD3 NUTX Summary - June 7, 2017

Sample	Time	HOURS	MIN.	ET	NO ₃ +NO ₂	gr NO ₃ +NO ₂ /m ² /day	TKN	gr TKN/m ² /day	TP	gr Total P/m ² /day
CFR-LD3-0617-00F	18:30	18	30		0.40		0.62		0.085	
CFR-LD3-0617-00I	15:30	15	30	180	0.39	0.0192	0.63	-0.0192	0.09	-0.0115
CFR-LD3-0617-0F	18:10	18	10		0.39		0.63		0.086	
CFR-LD3-0617-0I	15:45	15	45	145	0.39	0.0000	0.50	0.3098	0.09	-0.0072
CFR-LD3-0617-1F	18:20	18	20		0.38		0.51		0.094	
CFR-LD3-0617-1I	15:40	15	40	160	0.38	0.0000	0.47	0.0864	0.10	-0.0130
CFR-LD3-0617-2F	18:35	18	35		0.39		0.41		0.098	
CFR-LD3-0617-2I	15:45	15	45	170	0.38	0.0203	0.46	-0.1016	0.11	-0.0244
CFR-LD3-0617-3F	18:25	18	25		0.39		0.55		0.087	
CFR-LD3-0617-3I	15:40	15	40	165	0.38	0.0209	0.62	-0.1466	0.095	-0.0168
CFR-LD3-0617-4F	18:27	18	27		0.38		0.52		0.093	
CFR-LD3-0617-4I	15:35	15	35	172	0.38	0.0000	0.58	-0.1206	0.10	-0.0141
STATION MEAN NUTRIENT EXCHANGE RATE (gr/m ² /day):							0.001	-0.216		-0.008

*See Table B5 for data qualifiers

**Chambers 1 through 4 were in contact with the sediment. Chambers 0 and 00 were 'blanks' and represent water column respiration.

Table B4: Station BD NUTX Summary - June 8, 2017

Sample	Time	HOURS	MIN.	ET	NO ₃ +NO ₂	gr NO ₃ +NO ₂ /m ² /day	TKN	gr TKN/m ² /day	TP	gr Total P/m ² /day
CFR-BD-0617-00F	18:30	18	30		0.35		0.68		0.097	
CFR-BD-0617-00I	12:06	12	6	384	0.35	0.0000	0.55	0.1170	0.10	-0.0027
CFR-BD-0617-0F	18:10	18	10		0.35		0.49		0.098	
CFR-BD-0617-0I	12:07	12	7	363	0.36	-0.0095	0.45	0.0381	0.10	-0.0019
CFR-BD-0617-1F	18:15	18	15		0.30		0.49		0.16	
CFR-BD-0617-1I	12:10	12	10	365	0.33	-0.0284	0.67	-0.1704	0.20	-0.0379
CFR-BD-0617-2F	18:20	18	20		0.34		0.51		0.12	
CFR-BD-0617-2I	12:14	12	14	366	0.35	-0.0094	0.80	-0.2738	0.13	-0.0094
CFR-BD-0617-3F	18:23	18	23		0.36		0.70		0.11	
CFR-BD-0617-3I	12:17	12	17	366	0.35	0.0094	0.62	0.0755	0.11	0.0000
CFR-BD-0617-4F	18:27	18	27		0.28		0.73		0.14	
CFR-BD-0617-4I	12:13	12	13	374	0.29	-0.0092	0.84	-0.1016	0.18	-0.0370
STATION MEAN NUTRIENT EXCHANGE RATE (gr/m ² /day):							-0.005	-0.195		-0.019

*See Table B5 for data qualifiers

**Chambers 1 through 4 were in contact with the sediment. Chambers 0 and 00 were 'blanks' and represent water column respiration.

Table B5: Nutrient Exchange Data Qualifiers

Sample Name	Date/Time	Analyte	Result	Qualifiers	MRL
CFR-LD2-0617-2F	6/6/2017 18:25	Total Kjeldahl Nitrogen	0.58	H-6	0.05
CFR-LD2-0617-2I	6/6/2017 12:20	Total Kjeldahl Nitrogen	0.52	H-6	0.05
CFR-LD2-0617-3F	6/6/2017 18:24	Total Kjeldahl Nitrogen	0.44	H-6	0.05
CFR-LD2-0617-3I	6/6/2017 12:25	Total Kjeldahl Nitrogen	0.47	H-6	0.05
CFR-LD2-0617-4F	6/6/2017 18:21	Total Kjeldahl Nitrogen	0.45	J,H-1	0.05
CFR-LD2-0617-4I	6/6/2017 12:30	Total Kjeldahl Nitrogen	0.56	H-6	0.05
CFR-LD3-0617-00F	6/7/2017 18:30	Total Kjeldahl Nitrogen	0.62	J,H-1	0.05
CFR-LD3-0617-00I	6/7/2017 15:30	Total Kjeldahl Nitrogen	0.63	H-6	0.05
CFR-LD3-0617-0F	6/7/2017 18:10	Total Kjeldahl Nitrogen	0.63	H-6	0.05
CFR-LD3-0617-0I	6/7/2017 15:45	Total Kjeldahl Nitrogen	0.5	H-6	0.05
CFR-LD3-0617-1F	6/7/2017 18:20	Total Kjeldahl Nitrogen	0.51	J,H-1	0.05
CFR-LD3-0617-1I	6/7/2017 15:40	Total Kjeldahl Nitrogen	0.47	J,H-1	0.05
CFR-LD3-0617-2F	6/7/2017 18:35	Total Kjeldahl Nitrogen	0.41	H-6	0.05
CFR-LD3-0617-2I	6/7/2017 15:45	Total Kjeldahl Nitrogen	0.46	J,H-6,QM-2	0.05
CFR-LD3-0617-3F	6/7/2017 18:25	Total Kjeldahl Nitrogen	0.55	J,H-1	0.05
CFR-LD3-0617-3I	6/7/2017 15:40	Total Kjeldahl Nitrogen	0.62	J,H-1	0.05
CFR-LD3-0617-4F	6/7/2017 18:27	Total Kjeldahl Nitrogen	0.52	H-6	0.05
CFR-LD3-0617-4I	6/7/2017 15:35	Total Kjeldahl Nitrogen	0.58	H-6	0.05
CFR-BD-0617-2F	6/8/2017 18:20	Total Kjeldahl Nitrogen	0.51	J,QM-2	0.05

H-1: Recommended holding time exceeded.

H-6: Sample originally analyzed within holding time; some QC requirements not met. The reported result is from a second analysis performed for confirmation which occurred after the holding time expired.

J: The identification of the analyte is acceptable; the reported value is an estimate.

QM-2: Matrix Spike Recovery greater than method control limits.

**The absence of a sample ID indicates no qualifiers existed.

END OF REPORT